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New Mexico Instructional Scope

8th Grade Functions Guide

The purpose of this tool is to help educators understand each of the grade level standards and how those standards connect to the students' overall preparation for college and career readiness.

The NMIS is a teacher-influenced tool, designed to provide instructional planning support at the programmatic level for districts and instructional level for teachers. Its foundation stems from the vision and mission of the PED and came into existence to assure that students in NM will be engaged in a culturally and linguistically responsive educational system that meets the social, emotional, and academic needs of ALL students. This is also rooted in the belief that all students must have access to on-grade-level standards, focusing on acceleration. The purpose of this tool is to help educators understand each of the grade level standards and how those standards connect to the students' overall preparation for college and career readiness.

Standards are defined as the most critical prerequisite skills and knowledge. This document is color-coded to reflect both anchor and priority standards. Though previous emphasis was placed on priority standards to address lost learning due to COVID-19, New Mexico teachers should note that moving forward, while priority standards allow for acceleration of learning, all standards should be addressed in instruction throughout the school year.

In this guide you will find:

- A breakdown of each of the grade level standards within the cluster, including:
  - Standards of Mathematical Practice
  - Common Misconceptions
  - Identification of Priority Standards, as identified by NMPED.
  - Level of Rigor Identification
- Sample aligned assessment items
- Suggested Student Discourse Guide
- A multilayered system of supports (MLSS) and culturally and linguistically responsive instruction (CLR) guide

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Key		
	Priority Standard	Priority standards, as identified by NMPED, are denoted with red highlighting. Priority standards are the most critical prerequisite skills and knowledge a student needs. This does not mean that these are only standards required to be taught, just these are the standards that will allow for the acceleration the students of New Mexico need during this time.
	*Conceptual Understanding*	Conceptual Understanding standards help students build a deep understanding of the **how** and **why** of mathematics.
	*Application*	Application standards help students identify the appropriate concepts and skills to tackle **novel real-world problems.**
	*Procedural Skill and Fluency*	Procedural standards help students develop **efficiency** and **accuracy** in computations.

Standards Breakdown

- Define, evaluate, and compare functions.
  - 8.F.A.1
  - 8.F.A.2
  - 8.F.A.3
- Use functions to model relationships between quantities.
  - 8.F.B.4
  - 8.F.B.5

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**FUNCTIONS**	**Define, evaluate, and compare functions.**

Cluster Standard: 8.F.A.1

Standard	**Standards for Mathematical Practice**
Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	• **SMP 2**: Reason abstractly and quantitatively.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students understand that a **function** is a rule that takes an **input** and produces only one **output**; therefore, functions occur when there is exactly one y-value associated with any x-value. Students identify functions from equations, graphs, and tables/ordered pairs and are not expected to use the function notation f(x) at this level. This standard requires students to clarify the definitions of key terms including **function, input, output, y-value**, and **x-value**.	• Know and flexibly use the terms function, input, and output. • Analyze tables and graphs by interpreting their relationships as functions. • Understand that a function is a rule that states each input has exactly one output, not just how to recognize them. • Understand that each function produces a graph. • Formulate and defend opinion on whether a table or graph is a function or not with use of counterexamples.
DOK	**Blooms**
1-2	Understand, Apply

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**FUNCTIONS**	**Define, evaluate, and compare functions.**

Cluster Standard: 8.F.A.2

Standard	Standards for Mathematical Practice
Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change	• **SMP 4**: Model with mathematics. • **SMP 5:** Use appropriate tools strategically.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students understand that a **function** is a rule that takes an **input** and produces only one **output**; therefore, functions occur when there is exactly one y-value associated with any x-value. Students identify functions from equations, graphs, and tables/ordered pairs and are not expected to use the function notation f(x) at this level. This standard requires students to clarify the definitions of key terms including **function, input, output, y-value**, and **x-value**.	• Determine the slope and the y intercept from an equation, a table, a graph, and a verbal description. • Explain orally and in writing that slope represents rate of change and y-intercept represents initial value or starting value. • Understand how to generate additional ordered pairs for a function. • Compare the properties of a graph, an equation, a table, and verbal descriptions given a real world linear situation.
DOK	**Blooms**
1-2	Analyze, Evaluate

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**FUNCTIONS**	**Define, evaluate, and compare functions.**

Cluster Standard: 8.F.A.3

Standard	**Standards for Mathematical Practice**
Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s^2 (s squared) giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.	• **SMP 1:** Make sense of problems and persevere in solving them. • **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students understand that a **function** is a rule that takes an **input** and produces only one **output**; therefore, functions occur when there is exactly one y-value associated with any x-value. Students identify functions from equations, graphs, and tables/ordered pairs and are not expected to use the function notation f(x) at this level. This standard requires students to clarify the definitions of key terms including **function, input, output, y-value**, and **x-value**.	• Understand that a linear function has a constant rate of change called slope and will produce a line on a graph. • Understand that a nonlinear function does not have a constant rate of change and will not produce a line on a graph.
DOK	**Blooms**
1-2	Understand, Apply, Analyze

Common Misconceptions

- It is vital to ensure students have a common understanding of the vocabulary terms in this unit as common errors are often correlated to the confusion of the terms function, input, output, x-value, and y-value. Students can confuse the relationship between an input and output and the idea that each input only has one output. When making connections to graphs and tables, this same confusion is found when using the terms x-

value and y-value. The confusion around the relationship between the input and output is heightened when students realize that more than one input can give the same output.

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**FUNCTIONS**	**Use functions to model relationships between quantities**

Cluster Standard: 8.F.B.4

Standard	**Standards for Mathematical Practice**
Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	• **SMP 4**: Model with mathematics. • **SMP 7**: Look for and make use of structure.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students determine and interpret the rate of change and the initial value to construct a linear model. They use a real-world situation to sketch a graph and use a graph to write a verbal description of a real-world situation.	• Write the function for a linear relationship between two quantities. • Identify the rate of change • Identify the slope of the function from two points (x,y), from a graph and a table. • Interpret the rate of change (slope) and initial value of a linear function from a table, graph, equation or verbal description. • Calculate the slope of a line using the rise over run ratio.
DOK	**Blooms**
1-3	Apply, Analyze

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Grade	*CCSS Domain*	*CCSS Cluster*
8	**FUNCTIONS**	**Use functions to model relationships between quantities**

Cluster Standard: 8.F.B.5

Standard	**Standards for Mathematical Practice**
Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	• **SMP 3:** Construct viable arguments and critique the reasoning of others. • **SMP 4**: Model with mathematics.
Clarification Statement	**Students Who Demonstrate Understanding Can...**
• Students determine and interpret the rate of change and the initial value to construct a linear model. They use a real-world situation to sketch a graph and use a graph to write a verbal description of a real-world situation.	• Interpret linear and nonlinear graphs. • Describe the relationships between two quantities (linear, nonlinear, increasing or decreasing). • Sketch graphs of linear and nonlinear functions. • Analyze the sketches of linear and nonlinear functions.
DOK	**Blooms**
1-3	Analyze, Create

Common Misconceptions

- Students may use different scales on the axes and then try to compare rates. Point out that in order to compare the constant rate of change visually, the scales and labels on the axes must be the same. Make sure students identify the correct scales on a graph, not all scales increase by 1 or by the same increment.

Student Discourse Guide

- **Purposeful, rich classroom discourse offers students the opportunity to express their ideas, thinking, and to critique the reasoning of others in a variety of ways (writing, drawing, verbal). Purposeful implementation of classroom discourse allows students to activate funds of knowledge and to refine their mathematical understanding. When students have frequent opportunities for discourse, they find various paths to solutions and reveal knowledge or misunderstandings to educators. The process also allows educators to honor students' culture, lived experiences and evolving math identities.**
- **Discourse that focuses on tasks that promote reasoning and problem solving is a primary mechanism for developing conceptual understanding and meaningful learning of mathematics (Michaels, O'Connor, and Resnick, 2008)**

Domain: **Functions**	Strand**: Define, evaluate, and compare functions**.

Suggested Student Discourse Questions

- How do you know whether a relationship between two quantities is a function or not?
- Do you agree with (a student's name) strategy on determining whether a relation is a function? Why or why not?
- How can you connect functions to vending machines?
- What are inputs and outputs and how do they relate to functions?

Domain: **Functions**	Strand: **Use functions to model relationships between quantities**

Suggested Student Discourse Questions

- How can a graph, table, ordered pair, or an algebraic rule help describe the relationship between two variables?
- Can you find the error in _____'s work? Why do you think it is an error? Can you explain your thinking?
- What type of data could we collect in everyday life that would show a linear relationship? A quadratic relationship?
- Are all linear equations functions? Why or why not? Can you provide a counterexample?

ASSESSMENT GUIDE

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities

Grade	*CCSS Domain*	*CCSS Strand*
8	**Functions**	**Define, evaluate, and compare functions.**

Sample Task #1 (Constructed Response)

Laney and Maka are tutors. Laney charges $10 for travel expenses plus $32 per hour of tutoring. The dollar amount Maka charges can be modeled by the equation $F = 30h + 14$, where h represents the number of hours that Maka tutors and F represents the total amount earned.

What is the difference in the total amount Laney and Maka each charge for 4 hours of tutoring?

Sample Task #2 (Multiple Choice)

Consider this set of ordered pairs.

$\{(2, 4), (3, 8), (6, 2), (x, 5)\}$

Which missing x-value makes this set of ordered pairs a function?

Ⓐ 2
Ⓑ 3
Ⓒ 5
Ⓓ 6

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Grade	*CCSS Domain*	*CCSS Strand*
8	**Functions**	**Use functions to model relationships between quantities**

Sample Task #1 (Constructed Response)

For an experiment, Trent used weights to stretch a spring. First, he used a centimeter ruler to measure the length of the spring. He attached a weight to one end of the spring and measured its length again. He then measured the length of the spring with different-sized weights attached. This table shows the data collected from Trent's experiment.

Spring Experiment

Weight (grams)	Length (centimeters)
10	15
30	25
50	35

a. What is the rate of change? Show your work or explain how you know.

b. What does the rate of change represent?

c. Write an equation that represents the length of the spring, y, with x grams of weight added. Show your work or explain how you know.

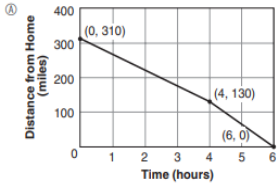
Sample Task #2 (Multiple Choice)

The following describes Jason's trip as he rode a bus home from college:

- The bus traveled a total distance of 310 miles.
- During the first part of the trip, the bus traveled at a constant speed of 45 miles per hour.
- During the second part of the trip, the bus traveled along a highway at a constant speed of 65 miles per hour.

Which graph represents Jason's trip on the bus, showing his distance from home as a function of time?

Ⓐ



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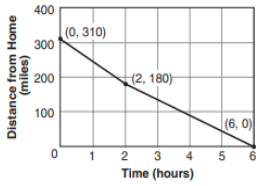

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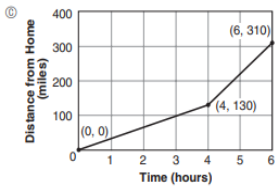

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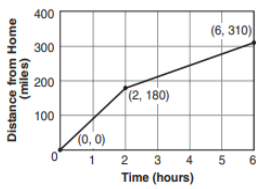

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MLSS AND CLR GUIDE

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities

CCSS Domain	*CCSS Cluster*
Functions	**Define, evaluate, and compare functions**

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on how to define, evaluate and compare functions , consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, students may provide ideas for what kids of relationships can be shown using a function. These relationships or situations can be unique to the learner's home culture or surrounding community. This is an opportunity for students to connect real word scenarios to mathematics.	
Cross-Curricular Connections	• **Science:** Physical Science constant speed/average speed • **Social Studies**: Geography/History of Travel looking at distance/time • **Art:** Mixing Paint adjusting paint parts to create a certain shade/quantity • **Gym**: Keeping score in a game (For every touchdown, you get x amount of points)	
Validate/Affirm/Build/Bridge	• *How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?* • *How can you create connections between the*	• Facilitating Meaningful Mathematical Discourse: Mathematics discourse requires intentional planning to ensure all students feel comfortable to share, consider, build upon and critique the mathematical ideas under consideration. When student ideas serve as the basis for discussion, we position them as knowers and doers of mathematics by using equitable talk moves students and attending to the ways students talk about who is and isn't capable of mathematics we can disrupt the negative images and stereotypes around mathematics of marginalized cultures and languages. "A discourse-based mathematics classroom provides stronger access for every student — those who have an immediate

	cultural and linguistic behaviors of your students' home culture and language, the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?	answer or approach to share, those who have begun to formulate a mathematical approach to a task but have not fully developed their thoughts, and those who may not have an approach but can provide feedback to others." For example, when studying how to define, evaluate and compare functions, facilitating meaningful mathematical discourse is critical because it is important to motivate students to define the meaning of a function as they understand it. Allowing students to communicate their different definitions of a function by analyzing different relationships. In this way students are led to not only share their ideas but also to listen to others in a positive way. Students may be asked or challenged to defend their ideas, and this gives way to building discourse as a mathematical community of learners.

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	*Current Learning*	*Future Learning*
• In 7th grade, learners analyze proportional relationships and use them to solve real world and mathematical problems. They solve real-world and mathematical problems using numerical and algebraic expressions and equations These previously learned skills help build connections between expressions and linear equations in Grade 7 to linear relationships of functions in Grade 8	• This learning connects to the learning that will occur later in 8th grade when students begin analyzing graphs of functional relationships and construct functions to model relationships between two quantities.	• In high school, students make connections to the learning done within this cluster when they interpret functions that arise in application in terms of the context.

Suggested Instructional Strategies

Pre-Teach

Level of Intensity	*Essential Question*	*Examples*

Targeted	*What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*	For example, some learners may benefit from targeted pre-teaching that previews new contexts for tasks within the unit (e.g., cell phone plans) when studying how to define, evaluate and compare functions because this allows the learner to become engaged with the content in real world situations. This helps to build interest as well as expose the learner to new content. Students can also begin to form basic definitions of a function by being exposed to new contexts.
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	*7.RP.A.2 : This standard provides a foundation for work with how to define, evaluate and compare functions because students must first develop an understanding of proportional relationships and how they correspond among a table, graph and equation. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.*

Universal Support Framework

A student should know/understand...	A student should be able to do...	***Potential Scaffolds***

• A function is a rule that states each input has exactly one output.
• Slope represents rate of change and y-intercept represents initial value or starting value.
• A linear function has a constant rate of change called slope and will produce a line on a graph.
• A nonlinear function does not have a constant rate of change and will not produce a
	• Determine whether a table or graph models a function.
	• Compare properties of functions presented in the same and different forms.
	• Find the slope and the y-intercept from an equation, a table, a graph, and a verbal description.
	• Generate additional ordered pairs for a function. (ex: extend a table, extend a graph, evaluate an equation).
	•
		• Build on students' experience with the following skills:
		  ○ Analyze proportional relationship
		  ○ Solve problems using numerical and algebraic expressions and equations
		
		• Cognitive Strategies
		  ○ Repeatedly model the strategies
		  ○ Monitor the students' use of the strategies
		  ○ Provide feedback to students
		  ○ Teach self-questioning and self-monitoring strategies
		  ○ Introduce multiple means of representation for mathematical ideas
		
		• Encourage students to use alternative tools to better access the grade level content. Examples include:
		  ○ Graphic Organizer with Functions/Non-Functions

line on a graph.		○ Task Cards/Google Slide/Sort
Re-Teach		
Level of Intensity	***Essential Question***	***Examples***
Targeted	What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisited during a unit?	For example, students may benefit from re-engaging with content during a unit on how to define, evaluate and compare functions by providing specific feedback to students on their work through a short mini-lesson because if a student is struggling with understanding that a function is a rule that assigns exactly one output to one input. These misunderstandings can go back throughout elementary and relate to a 5 misunderstanding of proportionality. This can be a quick exit ticket of defining a function of a table. Then feedback should be given promptly
Intensive	What assessment data will help identify content needing to be revisited for intensive interventions?	For example, some students may benefit from intensive extra time during and after a unit on how to define, evaluate and compare functions by addressing conceptual understanding because students should be able to apply their understanding of defining, evaluating and comparing functions in different contexts. The teacher should be able to see that the students can define functions based on different representations and contexts.
Extension		
	Essential Question	***Examples***
	What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?	For example, some learners may benefit from an extension such as in-depth, self-directed exploration of self-selected topics when studying how to define, evaluate and compare functions because students can transfer their understanding into different scenarios where a function is an appropriate representation of the data. The burden of proving that this is a function relationship will depend on their ability to display and make connections between functions and how to evaluate if the example is really a function. Students can connect the verbal rule of the function with a representation in a table, and then a graph and an expression

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CCSS Domain	*CCSS Cluster*
Functions	**Use functions to model relationships between quantities**

Culturally and Linguistically Responsive Instruction

Relevance to Families and Communities	During a unit focused on using functions to model relationships between quantities, consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, students can complete an experiment at home with family members where they are measuring heart rate as a function, with and without jumping jacks. Students can display their findings about the increase in beats per minute as a function on a graph. These findings can then be brought and shared in the classroom environment.	
Cross-Curricular Connections	• **Science**: Students could examine scientific data and predict the effect of a change in one variable on another	
Validate/Affirm/Build/Bridge	• *How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?* • *How can you create connections between the cultural and linguistic behaviors of your students' home culture and language, the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?*	• Eliciting and Using Evidence of Student Thinking: Eliciting and using student thinking can promote a classroom culture in which mistakes or errors are viewed as opportunities for learning. When student thinking is at the center of classroom activity, "it is more likely that students who have felt evaluated or judged in their past mathematical experiences will make meaningful contributions to the classroom over time." For example, when studying using functions to model relationships between quantities eliciting and using student thinking is critical because this contributes to the classroom culture of all learners being mathematicians. Allowing students to express ideas as an opportunity to share thinking in different representations such as drawings, graphs, and verbal descriptions fosters confidence in the conclusions they have made. Students who work together and share ideas in cooperative groups benefit from comparing their models of functions and those relationships.

Planning for Multi-Layered System of Supports

Vertical Alignment

Previous Learning	*Current Learning*	*Future Learning*
• In 7th grade, students analyze proportional relationships and use them to solve real-world and mathematical problems. Students solved real-world and mathematical problems using numerical and algebraic expressions and equations.	• In 8th grade, students graph proportional relationships, interpreting the unit rate as the slope of the graph. Students are working to interpret the equation y = mx + b as defining a linear function and understand that a function is a rule that assigns to each input exactly one output. By the end of 8th grade, students will compare properties of two functions each represented in a different way.	• In high school, students begin to apply the concept of a function with use of function notation. Students will interpret functions that arise in application in terms of the context.

Suggested Instructional Strategies

Pre-Teach

Level of Intensity	*Essential Question*	*Examples*
Targeted	*What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*	For example, some learners may benefit from targeted pre-teaching that previews new contexts for tasks within the unit (e.g., cell phone plans) when studying use functions to model the relationship between quantities because this allows the learner to become engaged with the content in real world situations. This helps to build interest as well as expose the learner to new content. Students can also begin to form basic definitions of a function by being exposed to new contexts.
Intensive	*What critical understandings will prepare students to access the mathematics for this cluster?*	*7.RP.A.2: This standard provides a foundation for work with use functions to model the relationship between quantities because students must first develop an understanding of proportional relationships and how they correspond among a table, graph and equation. If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the*

		unit to ensure students are ready to access grade level instruction and assignments
Universal Support Framework		
A student should know/understand...	A student should be able to do...	***Potential Scaffolds***

• Slope represents rate of change and y-intercept represents initial value or starting value.
• How to identify if the graph of a function is increasing or decreasing.
• How to identify if the graph of a function is linear or nonlinear.
• Connections between verbal descriptions and graphs of functions.
	• Determine the rate of change and the initial value when given two (x, y) values, a verbal description, a table of values, a graph, or an equation.
	• Interpret the rate the change (slope) and the initial value (y-intercept) in terms of a real-world situation.
	• Construct a function to model a linear relationship.
	• Sketch a graph that represents a real-world situation and create a story that represents the features of a graph.
		• Build on students' experience with the following skills:
		  ○ Analyze proportional relationships
		  ○ Solve problems using numerical and algebraic equations and expressions.
		
		• Cognitive Strategies
		  ○ Repeatedly model the strategies
		  ○ Monitor the students' use of the strategies
		  ○ Provide feedback to students
		  ○ Teach self-questioning and self-monitoring strategies
		  ○ Introduce multiple means of representation for mathematical ideas
		
		• Encourage students to use alternative tools to better access the grade level content. Examples include:
		  ○ Graphic Organizer (Rule of Four)
		  ○ Colored Pencils/Highlight

Re-Teach		
Level of Intensity	***Essential Question***	***Examples***
Targeted	What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisited during a unit?	For example, students may benefit from re-engaging with content during a unit on use functions to model the relationship between quantities by critiquing student approaches/solutions to make connections through a short mini-lesson because students may display small misunderstandings that could hinder their comprehension. Graphs are everywhere in the study of functions, but it is important to distinguish a function from its graph. For example, a linear function does not

		have a slope, but the graph of a non-vertical line has a slope.
Intensive	What assessment data will help identify content needing to be revisited for intensive interventions?	For example, some students may benefit from intensive extra time during and after a unit use functions to model the relationship between quantities by addressing conceptual understanding because students use functions to model relationships between quantities, which makes this cluster one that has a primary focus on application problems. This builds on previous work with algebraic patterns, input/output rules, and ratios and proportional relationships for which students should be able to apply to real world situations.

Extension	
Essential Question	***Examples***
What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?	For example, some learners may benefit from an extension such as open-ended tasks linking multiple disciplines when studying and use functions to model the relationship between quantities because this leaves opportunity for class discussion that offers students to verbally show their thinking. Students can create an extension activity that can be used with peers that examine connections between (x,y) values and interpret them from a table or graph.